THE ELECTRICAL WORLD

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## The Clay Telephone System.

The people of the United States are essentially anti-monopolistic, even though the laws which themselves have framed establish monopolies and protect them from encroachment. Our patent law is a forcible example illustrating this anomaly. No man gifted with that foresight which extends beyond the day questions the expediency of that law when he considers that the monopolies established by the law are but temporary in existence and are premiums to encourage invention.

Invention incontestably has been and is one of the great factors of the successful growth in prosperity of this country, and without question would not have continued to exist without hope of the premium so liberally and judiciously granted.

When any great invention comes to the front, and is adopted by the public, the promoters of the invention are sure to claim, whether justly or not, exclusive right to the invention under the patent, or patents, which they own and claim to be *prima facie* evidence of their title to protection for their property under the law.

But there are sure to be those who deny, justly or otherwise, the claims of the patentee, saying that the invention is not new, and that the patent therefor has been unjustly granted, or that it is not so broad in its scope as the patentee and friends claim, because of the state of the art as it existed before the time of the alleged invention. An appeal to the courts is made, and after a time the question is settled for or against the claims of either party.

No stronger illustration of this general statement can be found than the present state of the controversy relating to the invention of the telephone.

There are those who firmly believe that Bell is an original and the first inventor of the practical telephone; and there are as many, at least, who firmly and honestly believe he was not, and they cite in evidence of their belief the real and imaginary operations of Bourseul, De Meucci, Reis, Drawbaugh and others.

The invention having been made, the public desires it to be placed within its reach at the lowest possible price, and of the highest efficiency; and it is willing to patronize, of the parties to the controversy, that one which gives the best for the least money, leaving the merits of the controversy to be settled between those more closely interested. It follows from the nature of the case that the one which acts as well as controverts will receive the coveted patronage of the anti-monopolistic public of which we first wrote; because it questions the justice of the monopoly as it exists or as its supporters and direct beneficiaries desire it to be.

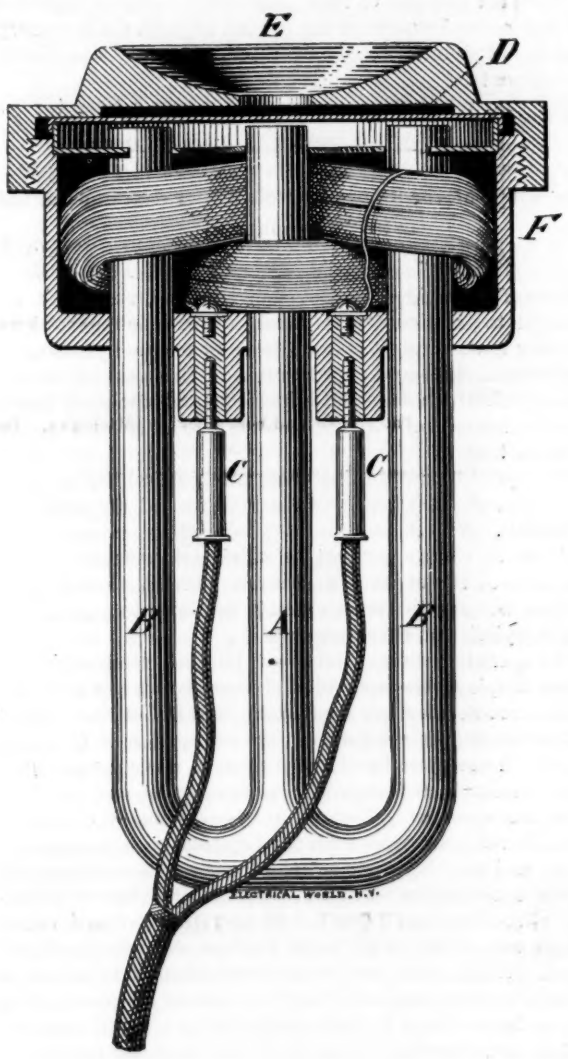
The Clay Commercial Telephone Co. of Philadelphia has the courage of its convictions, and therefore acts as well as talks. It has established in that city an exchange which has now about two hundred and fifty subscribers among the produce commission houses, wholesale grocors, bankers, brokers, banks and clearing houses. We are also informed that over four hundred subscribers have been obtained to an exchange for the benefit of the public generally of the city.

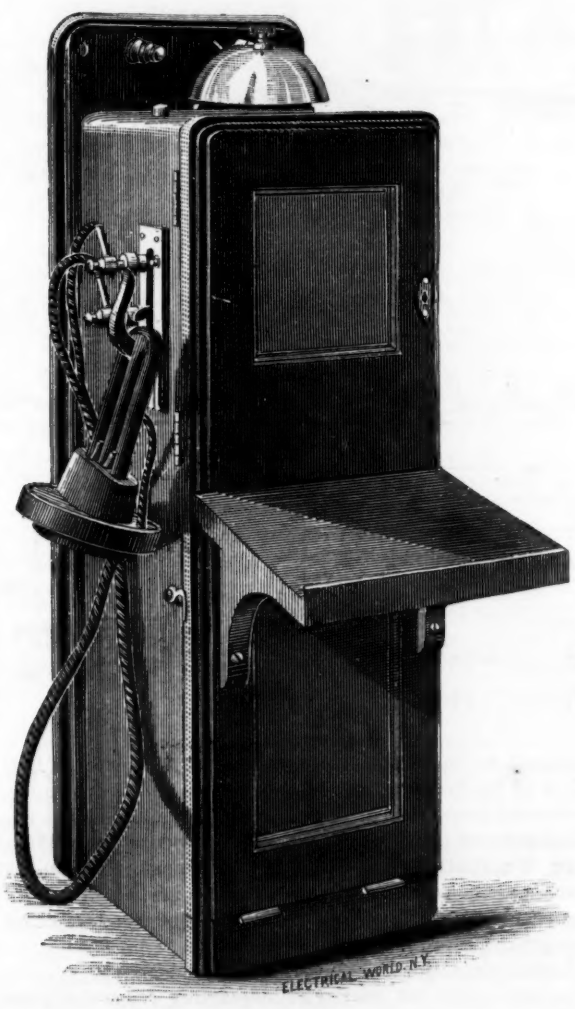
We recently visited the company's office in Philadelphia, and were shown its special apparatus, which we herein illustrate and describe for the information and benefit of our readers.

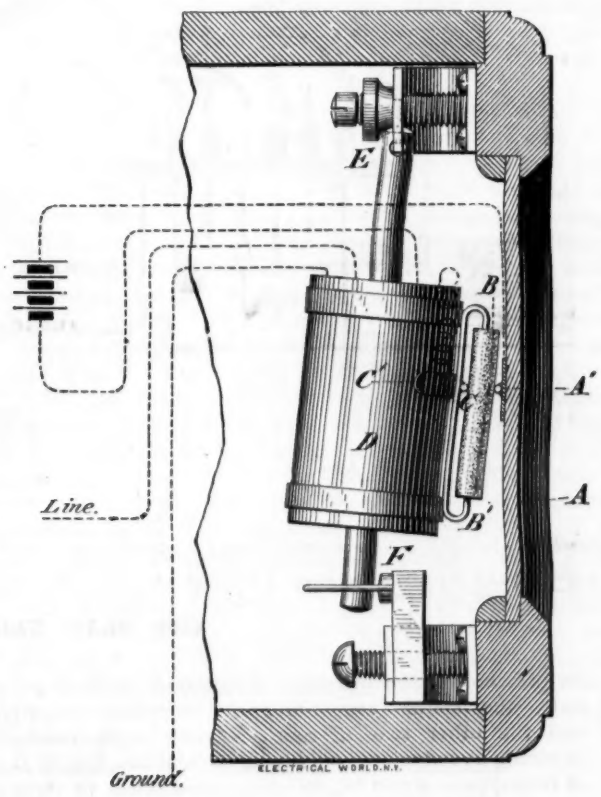
Fig. 1 is a view of the exact size of the Clay receiver; partly in perspective and partly in section for ease of description. Fig. 2 is a perspective view of the Clay call, transmitter, receiver, and battery-box as they are associated and placed in the subscribers' offices or residences. Fig. 3 is part-sectional view of one of the Clay transmitters, but without any of the accessories shown or implied in Fig. 2. This view is three-fourths linear size. Fig. 4 is a view of the Clay exchange-switch which is operated by any two of the subscribers themselves whenever they have ceased talking with each other.

*A* is the diaphragm of the transmitter, Fig. 3. It is also shown as the upper panel, the one above the inclined shelf, of Fig. 2. It is of wood, square, between $\frac{1}{16}$ and $\frac{1}{8}$ of an inch thick, and firmly fastened at its edges to the box which incloses the other operative parts. At the centre of this diaphragm is fastened a metallic plate on which is the platinum contact-piece *A'*. *B* is a carbon, tubular cylinder which fits loosely on the wire *B'*, which is bent so that its two ends enter the hole in the cylinder *B*. This wire is soldered to the metal arc *C'*, which is fastened to the insulating cover or casing of the induction coil *D*. Between the carbon cylinder and the wire, and soldered to the latter, is another platinum contact, *C*. The core *E F* of the induction coil is a rod of very hard cast-iron. It is claimed that a core of this material is much more sensitive to telephonic variations of magnetism than is either steel or soft-iron. The core *E F* has a transverse hole in it as shown at *E*, and is thereby loosely hooked on to one limb of a U-shaped spring, the other limb of which is screwed to the box as shown. The distance apart of the limbs of the spring is determined by a set-screw and jam-nut as shown. The other end, *F*, of the core of the induction coil is allowed to move loosely between the limbs of a U-shaped guide wire shown projecting horizontally from the mass of iron, at *F*, which is also fastened to one limb of a metal spring like that described as at *E*. This spring also has an adjusting set-screw. The battery is shown by the conventional sign, and the circuits by the dotted lines. The primary circuit is from the battery to the plate *A'* and its platinum contact through the carbon cylinder, platinum contact *C*, and primary coil of the inductorium to the battery. The secondary coil is connected to line and ground as usual. The adjustment is effected, firstly, by means of the set-screw at *E*, moving it in or out until the inductorium *D* presses the contacts *C* and *A'* against the carbon cylinder to the desirable and proper degree. The degree of pressure is determined by the deflection of the core *E F* from a vertical position.

An inward deflection of the diaphragm from impact of sound waves imparts to the inductorium a movement and momentum which would, unrestrained, break the contacts between the electrodes and thus destroy the continuity of the current so desirable in telephony. This apparatus, however, carries with it its own corrective and improver. It is well known that increased pressure between surfaces, such as we are considering, decreases the resistance of the circuit, of which the contact surfaces form a part; that such decrease of resistance causes increase in the strength of currents flowing in the circuit; and



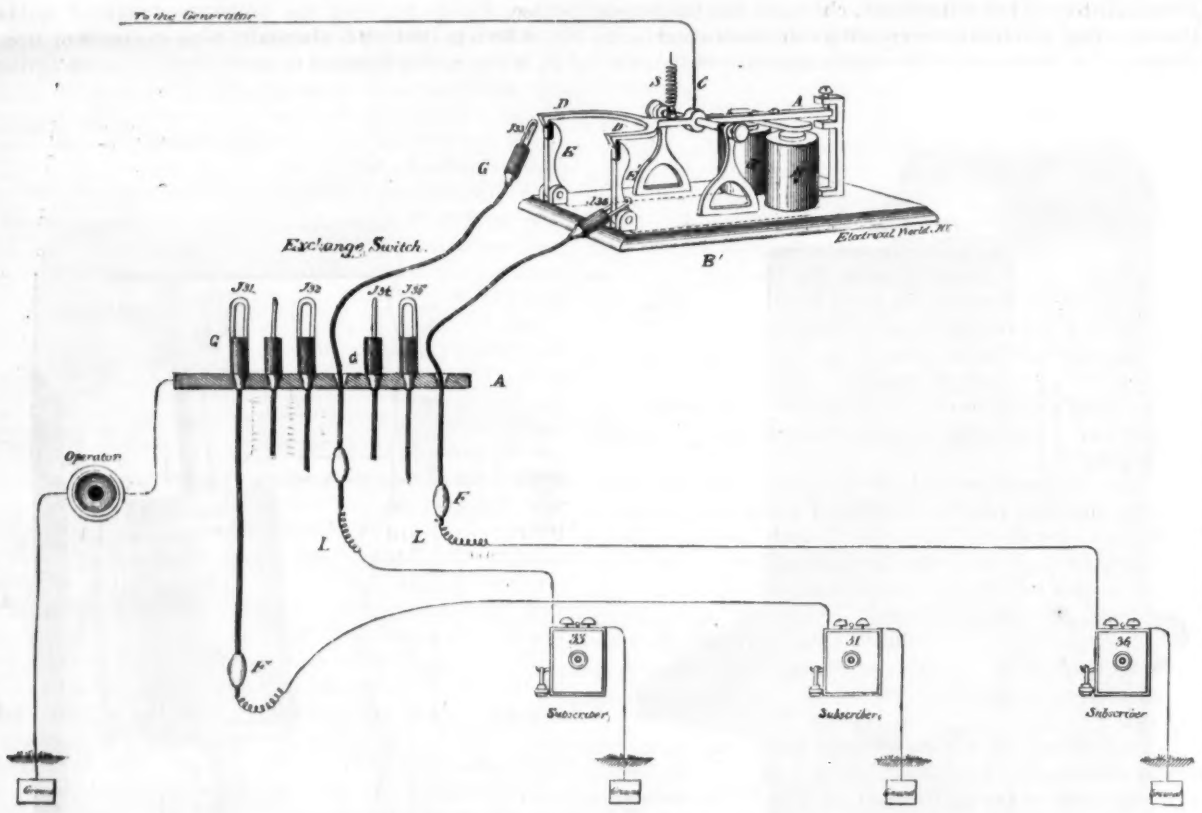

THE CLAY TELEPHONE: FIGS. 1, 2 AND 3.

that there is a corresponding increase of the magnetic attractive force of an an electro-magnet within the circuit. In this case, then, increased pressure between the contact surfaces causes the core to correspondingly attract the iron mass at *F*; and, as that mass is fixed, the core moves toward it to counteract the tendency which would otherwise become active, to break the contacts between the electrodes.

The practical results are these: The circuit is kept continuous within the limits necessitated by loud and violent talking at the transmitter, and that without any precise or exact adjustment. The transmitter responds to a weak and to a loud voice equally well, though of course not in equal strength. Loud or violent talking does not produce a rattling sound in the receiver, as is the case with the ordinarily adjusted transmitters familiar to the public.

It is claimed that the wooden diaphragm is superior to those of other material. From the known superior resonant qualities of dry wood, as, for instance, in violins and other musical instruments, this claim seems to be well founded. Sometimes the transmitters are provided with a trumpet-shaped mouth-piece over the diaphragm. It was stated to us that this became necessary because of the public having been educated to speak into an orifice, and it did not readily adapt itself to the new order of things telephonic.

The receiver is shown full-size in Fig. 1. *A B B* represent a permanent steel magnet of which the limb *A* is of one polarity, and the two limbs *B B* have their magnetism of opposite polarity divided between them; so that there




THE CLAY TELEPHONE: FIG. 4.

are presented to the ferrotype diaphragm *D* three polar ends, the centre one being say of north polarity, and the other two of south polarity, each one-half as strong as the middle one. The circular diaphragm *D* is of ferrotype iron and has its edge turned down to form a rim, as with a tin box-cover, to fit a shallow box made of ordinary sheet iron. This box has the centre of its bottom cut out so that there is considerable space between it and the pole of the limb *A*. There are two holes cut in the bottom somewhat eccentrically to its centres, so that when the box is put in its place on the magnet poles it may, by turning it on its own plane, be caused to enter slots cut in the two poles *B B*, as shown, and be fastened in position thereby. When once so fixed in place and the diaphragm put on the box, there is no means of adjustment, and it is claimed that none is needed.

The possible amplitude of vibration of the diaphragm is much greater than is usually the case with the Bell receiver. This favorable condition is due to the strong magnetic field provided under the construction of the instrument. The box and cover may be said to be one pole of the magnet and the end of the limb *A* the other. Of course, variations of the strength of current in the coils *F* of the receiver produce changes in the strength of the magnetic field corresponding to its primal strength. *C C* are the terminals of the usual receiver cord-conductor, connected with the ends of the coil *F* of fine wire as usual. The winding of *F* is peculiar in its way of surrounding the poles. It is shown so well in the figure that it need not be described. Suffice it to say that it is first wound as a skein of suitable size, and is then formed as shown and placed over the poles. It is cheaply and easily so made; but, though it works effectively, we doubt not that three bobbins, one for each pole, connected in series, would be more efficient and effective.

A virtue is claimed for this form of winding It is that the effects of induction from other lines are obviated by this construction. It is evident to to us, however, that all currents, whether from a battery, or from the induction coil of the connected transmitter, or from induction by contiguous lines, must produce their due effects in this instrument, as in any other. It must respond to all if to one. It seems to be impossible to provide in any receiving instrument against currents produced in the line by extraneous causes. *E* is the hard-rubber ear-piece which is screwed to a hard-rubber case covering the coil, and which is also brought to bear upon the edge of the diaphragm to keep it in place.

The receiver is hung upon a fixed hook as shown in Fig. 2. When it is removed by the operator a tongue projecting from the box within the bow of the hook is raised by the removal. The raising of the tongue moves a switch within the box to make the necessary electric circuits. The battery jar is placed within the cupboard below the inclined shelf, and this latter is used as a place for writing while making notes of conversation over the line.

Fig. 4 is a view, partly in diagram, of the Clay automatic exchange switch and system. *A* represents a perforated metallic plate in electrical connection with the telephone at the central office, and *B* represents a magnet which is properly supported on a base, *B'*.

*C* represents an armature for the electro-magnet *B*. This armature is mounted on the base *B'*, and two catches, *D D*, are pivoted to it at the end opposite to said magnet. Two levers, *E E'*, are pivoted to the base, and are arranged to abut, respectively, against the catches *D D* when in normal position. This position is vertical, but a horizontal or inclined arrangement may be adopted instead. The levers are provided with springs or weights for holding them in normal position, and they are insulated from the catches at the points of contact, They are also insulated from each other by the base *B'*, which is of wood, or other insulating material.

*L* represents the line-wires which lead to the various subscribing stations, each wire depending from the plate *A* through one of the perforations thereof, and having at top a metallic piece *G*, which is held in contact with the wall of the perforations of the plate *A*, the wire having an attached plate *F*, or being otherwise weighted to insure the contact of the piece *G* and plate *A*. The top of each wire terminates in an eye, *J*, which, when the wire is raised, may be fitted on either of the two levers *E*. To complete the circuit a wire extends from ground to the telephonic instrument of the subscriber, as at Nos. 31, 33 and 36. On line 31 the circuit is from ground through subscriber's transmitter to plate *A*, thence to operator's receiver and thence to ground. Like circuits for all subscribers exist when the plugs are in their seats in plate *A*.

The operation is as follows: When subscriber No. 33 wishes to communicate with some other subscriber, he first removes his telephone from its hook, which forms part of the signaling instrument. This removal allows the mechanism of the signaling instrument to close the circuit with the central office through the connections above described. After the central office learns the requisition from subscriber No. 33, the operator takes the eye $J^{33}$ of the line wire $L^{33}$, and attaches it to lever *E*. In so doing, the eye $J^{33}$ is necessarily brought into electrical contact with the catch *D* for said lever, and lifts said catch. As this catch is in metallic connection with the generator by means of wire *C*, a momentary circuit is established through the telephone of subscriber 33, and this produces a gurgling noise, which notifies him that his requisition is attended to. The wire *L* and eye *J* of the subscriber who is called for are then manipulated in like manner, and when said metallic eye raises the catch *D*, with which it comes in contact, it completes a momentary circuit for that subscriber's notification through catch *E'* and connections, like those above described, except that the signaling instrument and not the telephone of the latter subscriber is in circuit. He will thus be notified by the sounding of his bell. Both the eye $J^{33}$ of the first-named subscriber and the eye $J^{36}$ of the latter subscriber are by this time in electrical contact with their respective levers *E*, on which they are hung. The circuit is then from ground of instrument 33 through its ground-wire, said instrument, line-wire $L^{33}$, eye $J^{33}$, lever *E*, through wire to magnet *B*, from magnet *B* through wire to the other lever on which eye $J^{36}$ is hung, thence through said eye and the line-wire $L^{36}$, through the instrument of subscriber 36 and its ground-wire to ground. When the parties 33 and 36 have finished talking, the telephones of their instruments are hung upon the respective hooks of their call-bells or signaling apparatus, which causes the mechanism of the latter to be set in motion. This generates a current of electricity for said call-bell mechanism, and this current (which follows the circuit last described) is of sufficient strength to magnetize the cores of magnet *B* and attract armature *C*, thereby raising the catches *D* from the levers *E*. The weights *F* of the respective telephone wires *L* will then cause the said levers to turn outwardly until the eyes *J* drop off from them, thus breaking the circuit. The springs or weights of said levers then return them to their normal position, and the catches *D* fall again by their own weight (the armature being no longer attracted) into the position shown in Fig. 4.

There are as many of these automatic switches provided at each central station as are needed to work the necessary number of simultaneously operated pairs of subscribers' instruments.

The Clay telephone apparatus works very satisfactorily.

## The Scope of the Bourseul-Reis Apparatus Considered as an Invention.

The published ideas of Bourseul and the subsequent reduction to practice by Reis must in future be regarded as relating to one and the same system of telephony, namely, the transmission and reproduction of that part of articulate speech which constitutes its pitch, and also such qualities as are discernible by a combination of several simple musical tones.

Such qualities are, for instance, laughing, whistling, etc., and most of what may be termed rhetorical emphasis or inflection. All these can be produced by a break and make of an electric contact or an electric current. Even the voice of the speaker may often be recognized in this system, because the recognition is definable to a great extent by pitch and inflection.

The speaking current, however, not only renders all the above simple and compound pitchtones, but it is a true and perfect rendition of the gradual rise and fall of each wave.

The consonants consist, with the exception of C, S and R, which are compound, of only one wave of peculiar form, occurring before or after a vowel tone, and they are hence non-musical. Vowels, on the other hand, consist of a number of pitchtones with fundamental-over-and-undertones, and may be produced electrically by a combination of current-breakers situated on different sides of a diaphragm or operated by both in and outgoing vibration, but the success of this experiment depends on tedious adjustment. While, however, such a production of vowel tones belongs under the possibilities of a musical telephone, they cannot be produced by break and make of a single contact, and do not, therefore, come under the scope of the Bourseul-Reis invention.

Since now articulate speech is not possible without consonants, and as these consist of only one wave, or as in C, S and R, of a repetition of this wave at a comparative slow measure, it follows that it is solely the form of the wave which defines the peculiar sound of each consonant, and to give this peculiar form is impossible electrically by a break and make of current; it is wholly non-musical, and constitutes the vital part of the speaking current, which, therefore, must be continuous. It is the knowledge of this vital principle which made the speaking telephone possible, and it is since its revelation by Mr. Bell that speaking by telephone became an "art," *i. e.*, something that can be controlled. When, therefore, a writer remarks "every one skilled in the art knows that a Reis apparatus will transmit and reproduce words," we naturally ask since when did the art as defined exist?

But, some will say, we have testimony that words and sentences were at various times understood by Reis, etc. So much the worse, I say, for Reis and his assistants that they did not turn to better advantage these valuable hints which a well-meaning good-luck threw across their path. Instead of this, speaking by telephone remained beyond their control, it was in their hands only a vague and haphazard demonstration, and even as such occurred only at rare intervals.

E. BERLINER.

July 3, 1884.

## Telephony.

*To the Editor of The Electrical World:*

SIR: Although very much has been written upon this subject, the invention, the principles involved, the apparatus employed and its application, with your kind permission I would like to add my mite to the grand whole.

So far as I am informed, the *idea* of the telephone, or "the electrical transmission and rendition of the spoken word," originated with M. Bourseul as early as 1854.

The means suggested were "vibratory plates, connecting metal wire and a galvanic battery," the vital elements of the telephone of to-day. I am not aware, however, that any material or conclusive tests or experiments were made by M. Bourseul, and in my opinion, according to the records, the honor of producing the first apparatus that could, did and will successfully transmit and reproduce the spoken word, or articulate speech, falls to Prof. Reis, of Germany.

In the United States it seems to have been already proven that on or about 1868 or 1870 D. Drawbaugh produced magneto and electro-mechanical devices for the transmission and reproduction of articulate speech, as did also Mr. McDonough, on or about the year 1875, and also Prof. E. Gray on or about the year 1876, and also Prof. A. G. Bell on or about 1877.

The honor and *advantage* of obtaining the first patent has fallen to Professor Bell, and although it bears date 1876 (about one year before he knew he had an invention for transmitting speech), this makes no difference, as the courts have decided that, "no matter whether he knew it or not, he (Bell) was the inventor."

This should be very encouraging to other inventors, as they also may invent something valuable sometime and *not know it*.

So much in brief as to the *idea* of the telephone and its history up to the first patent.

As to the principles involved in the first or Reis instruments, I believe, and I am of the opinion that it is maintained and generally admitted, that the Reis instrument will transmit speech *only* when the electrodes are in continuous contact, necessitating, therefore, a *continuously closed circuit*, and a *continuous undulating* (or varying) current.

This is the underlying principle shown and set forth in the Drawbaugh, McDonough, Gray and Bell inventions.

It is claimed by the Bellites that this is the *only* principle, and that there can be no other, and that all transmitters of articulate speech *are* and *must be* based thereon.

A favorite argument for this conclusion is—and it is held to be unimpeachable—"that the medium of air for conveying tones from one place to another is, and must be, continuous," and this being held to be true of air as a conveyer of sound, it must be true when the medium used is electricity, and that therefore the circuit and current must be continuous, and *especially the current*.

It is on this *continuous current* theory that the Bell patent is based and the so-called "Bell Telephone" operated, or claimed to be operated, and the famous suits of the American Bell Telephone Company were brought and fought.

It is to this feature, the *continuous current* theory, in telephony, Mr. Editor, that I take exception, and I hope you will permit me, through your columns, in the cause of science, to add a short chapter on telephony, relative to the transmission of speech by *make and break*, and by *intermittent* currents.

It may not be out of order to state here that I commenced experimenting upon telephones in the year 1878, and have continued the same, at various times, to date. That during such experimenting I have made careful observations, tests, and a record of results, and I have not found any reason for changing the line or direction of my experiments, or for changing my opinion as to the best principle for the practical and reliable transmission and reproduction of speech by electricity, and especially over and upon long lines, or between distant places.

I maintain that the most practical and correct method for the reliable transmission of speech will be found to be the employment of *intermittent* currents, or a "make and break" current or contact.

I claim:

1st. That in the transmission of speech by electricity it is essential and necessary to be able to use or utilize a current of great electro-motive force or power to do work.

2d. That you cannot overcome the resistance of distance without such a current.

3d. That you cannot operate electro-mechanical devices for receiving in direct circuit without it.

4th. That you cannot operate relays and repeaters without it.

5th. That you cannot produce full loud tones at the receiver without it.

In short, that in the electrical transmission and reproduction of speech, you must obtain a full and complete variation and utilization of a current of great strength or force, and to do this the telephone transmitter should produce *intermittent* currents, or must "make and break" contact, and control the battery by the action of the voice, similarly as the "Morse key" now controls the battery by the action of the hand, and in receiving or the reproduction of articulate tones by electro-mechanical devices, such instruments should not be so delicately made as to respond readily to extra or foreign induced currents, and the same should be adjustable, similarly as the "Morse" relay or sounder in telegraphy.

My argument is that instead of the *continuous current* principle being the "*only* principle" and a necessity, it is incorrect and defective, and for these and many other reasons:

1. By this method only a light, weak battery current can be used.

2. Only a slight variation of a light, weak battery current can be obtained.

3. That, being limited in battery power, only very short circuits can be operated in a practical manner.

4. That the receiving instruments must necessarily be made delicate and sensitive to respond to the light currents used.

5. That such receivers are defective in operation, responding readily to foreign induced currents, thus interfering with the articulation, and rendering the same unreliable and often wholly unintelligible.

My experiments have been largely in the direction of obtaining increased power, or current strength or force, over the line, to overcome the above defects, to overcome the resistance of distance, and to operate intermediate devices, such as relays and repeaters, that the receiver may be worked in a local circuit and entirely free from inductive effects. In the main I have based such experiments upon the use of *intermittent* currents, and I have been able to prove the correctness of my theories and the many advantages in various ways.

I have, for instance, inserted in the circuit with the transmitter, at the transmitter, chemical telegraph apparatus using chemically prepared paper, uponwhich a distinct, clear record of *dots* was obtained, while at the receiver all of the transmitted words were clearly understood.

I have also constructed the "Randall Lever Transmitter" under patent number 235,019, 1880, using a lever about ten inches in length. This instrument is a *polarity* transmitter, or a transmitter of alternating intermittent currents, the electrode upon the lever making contact with greatest force alternately, with the battery electrodes arranged on each side of the lever, thus changing the current to line, alternating positive and negative.

With this instrument, over a proper circuit, when the contact of the lever upon the electrodes could be distinctly heard, and a spark be seen on each side of the lever during operation, the articulation at the receiver was loud, clear and natural.

I have also more recently produced an adjustable transmitter that may readily be adjusted while in operation to suit the circuit, and adjusted in such a manner that a receiver in the circuit with a transmitter, *at the transmitter*, responds to the transmitters with such force and loudness that it is unpleasant to the ear, even several inches removed, the articulation being very indistinct and harsh; while at the receiver, *at the receiving station*, the articulation is reproduced in loud, full, clear and natural tones.

The circuit used was an artificial line of resistance coils and condenser, representing about eight hundred miles, on the basis of twenty ohms to the mile for the resistance, and for leakage, etc., a condensing surface of about two and one-half microfarads for each two hundred miles.

I cite these experiments and tests as proof of the correctness of my theories, and as demonstrating the use of an alternating intermittent current and a "make-and-break" current principle in telephony.

To obtain these results it is not enough that the transmitter accidentally makes and breaks contact, or accidentally produces an intermittent current, but,

1st. The transmitter must, by the aid of the vibrator and its contacts, transmit as many electrical vibrations or impulses as there are complete vibrations of the vibrator.

2d. That said electrical vibrations or impulses must be of varying power.

3d. That the electro-magnet of the receiver must always control the vibrator of the receiver; that is, similarly as the will of the human being controls the tongue, so must the electro-magnet of the receiving or reproducing instrument control its *tongue*, vibrator or armature, and at no time during conversation must the receiving magnet be permitted to entirely demagnatize, but before entire demagnatization can take place, or before the magnet loses control of its armature, the magnet must again be energized by an incoming current or impulse, when it will again actuate or vibrate its armature with greater or less force, according to the quality and force of the incoming current.

Let these conditions, Mr. Editor, be fairly obtained with telephonic devices, and it will not make any difference how much the transmitter "makes and breaks" contact, providing the impulses are in unison with the vibrator and of varying power.

With these conditions fairly obtained, with properly made apparatus, the telephone becomes reliable for *all* intercommunication and telephoning across the Continent, if not under the ocean, as common as on ordinary circuits, and I hope and believe more reliable.

Of this, however, with your kind permission, more anon.

CHAS. A. RANDALL.

NEW YORK, June 16, 1884.

## A Suit Against the Commercial Telegram Company.

Henry C. Gardiner, a lawyer of this city, who is a stockholder in the Commercial Telegram Company, has begun a suit in the Supreme Court, through Denel & Wilson, as his attorneys, against that corporation and the Bankers' and Merchants' Telegraph Company. He says that in September, 1882, Luther E. Shinn was the owner, by assignment from Stephen D. Field, the well-known inventor, of certain patents for improvements in telegraphy, particularly applicable to the reporting of quotations from commercial exchanges. Shinn associated with himself Stephen W. Fullerton and George W. Casper, and organized the Commercial Telegram Company, with a nominal capital of $50,000 in 500 shares. They divided the stock by voting 300 shares to Shinn and 100 shares to each of the other incorporators. In December they elected themselves directors of the company, and on the next day they again met and elected two other directors, and voted to increase the capital to $1,000,000. Fullerton was chosen President, Shinn Vice-President, Casper Secretary, and John B. Scott Treasurer.

A week later, Mr. Gardiner says, the Board directed the issue to themselves of the whole $1,000,000 of stock at par, and gave their personal checks in payment. When these checks were all assembled in the American Exchange National Bank, the Commercial Telegram Company appeared to have a credit of $1,000,000 there. The Board, however, immediately voted to buy Mr. Shinn's patents from him for $1,000,000, and the Treasurer drew a check in Shinn's favor for that sum. Mr. Shinn voted in favor of this purchase.

In March, 1883, Mr. Gardiner alleges Mr. Shinn gave the company 3,750 shares of stock, and at the same meeting the Board voted to make 2,000 shares of this gift a preferred 6 per cent. stock, and authorized the Treasurer to sell it at $30 per share. The purchasers are not known to Mr. Gardiner; but he says that one week later the Board directed the Treasurer to sell the company's common stock at 50, although the whole $1,000,000 was originally subscribed for by Shinn and his associates at par. Mr. Gardiner has 100 shares of common stock, which cost him $6,000.

In January, 1884, Mr. Gardiner says, the Commercial Telegram Company entered into a contract with the Bankers & Merchants' Telegraph Company, by which they gave to the latter Company for three years the right to use the Telegram Company's wires and patented apparatus, the Bankers and Merchants' Company being permitted to control the Telegram Company by the election of seven new directors as members of the Telegram Company's Board. In return for this the telegraph company agreed to pay to the Telegram Company, semi-annually, the interest on the 2,000 shares of preferred stock—$12,000 a year—and to defray the Telegram Company's current expenses. Thus the apparent purpose in organizing this latter concern, Mr. Gardiner says, was to secure the profit of the dividends on the preferred stock, which is presumably held by certain insiders, and the salaries of the officers, all of which are guaranteed by the Bankers & Merchants' Company.

Mr. Gardiner asks for a receiver, and that the incorporators be compelled to account for the $1,000,000 representing the original stock, and for the difference between par and the sales of stock made at $30 and $50 per share. He charges fraud, conspiracy and collusion, and alleges that he knew of none of these inside transactions when he bought his shares.

## Small Storage Batteries.

Mr. A. V. Meserole, the electrician, of 22 New Church street, has been experimenting with small storage batteries, and in reply to our request for information about them says:

The points of interest in my storage batteries are those that enable me to make a small battery that can be charged with a current produced from the ordinary carbon (Fuller bichromate) battery, two cells of which is all that is needed, or six cells of the regular blue vitriol battery (crowfoot gravity). The storage cells can be fully charged from these batteries in from six to twelve hours. They will then give a current powerful enough to run a small lamp for about four hours. By using a more intense current for charging, they would run for six hours on the lamp. The cells are composed of plates of specially prepared lead, so arranged that alternate plates are positive and negative. All the negatives are connected with one pole and all the positives with the other, positive, pole. The batteries would be found useful for any purpose where a powerful current would be required for a few hours' work, such as for lamps, motors and experimental use, as they can be kept fully charged by a comparatively weak battery. The charging battery at my office is what is known as the Fuller bichromate, two cells, and the storage cell is large enough to run a one-ohm incandescent lamp. Four cells would run an eight-ohm lamp, and so on, increasing. I think my battery is the only small storage cell that has been made that would run over thirty consecutive minutes. I have seen a French battery that would only run for about fifteen minutes after being charged.

THE
# ELECTRICAL WORLD,
PUBLISHED WEEKLY.

W. J. JOHNSTON, - Editor and Publisher.

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## THE DOG IN THE MANGER.

We have published one or two articles lately calling attention to the extraordinary manner in which the authorities of the English post-office have thrown obstacles of every kind in the way of the commercial development of the telephone and its use by the public. We who have enjoyed in this country, through the untiring enterprise and splendid business management of the Bell Company, a very rapid extension of telephone service from one end of the land to the other, can form but a poor idea of the difficulties that attend the opening of a telephone exchange in England and communication between even the largest cities only half-a-dozen miles apart. Already many more than 300,000 instruments have been put out here, and at the present rate of increase the 900 exchanges will soon number one thousand. Such rapid growth is noteworthy, and can be the better appreciated by looking at the condition of affairs in England, as revealed in a pamphlet that has just been published there, entitled "The Post-Office and the Telephone Companies."

This remarkable statement, supported by a weighty editorial in the London *Times* and a pungent article from the *Railway News*, confirms all that we have said previously on the subject. It appears that on the 31st of March the post-office telephone exchanges numbered only 17, with the paltry total of 748 subscribers, with the addition of trunk line systems between Liverpool and Manchester, Swansea and Cardiff, Talywain and Newport, having 35 subscribers. On the other hand, the United Telephone Company and its subsidiary companies had 66 exchanges, with a total of 10,632 subscribers actually joined up. Thus the total of telephone subscribers throughout the country is only 11,415. Now Great Britain, with its closely packed population of from thirty to forty millions, active, hardworking, and intelligent, is just the country where the telephone would be in most use, and where its advantages would be the greatest. But the figures given above are absurd in their insignificance, and the only explanation of them is to be found in the policy of the authorities to whom, under the present interpretation of the law, the control of the telephone has been committed. It is not unnaturally believed that the department interested intends to compel the public to wait for telephonic facilities until the patents of the companies have expired, under the apprehension that the development of telephonic enterprise meantime may interfere with the revenue from telegraphs.

The United Telephone Company holds the master patents of Bell, Edison and Blake for England, but under the decision of the courts that telephony was included in telegraphy, the Postmaster-General's monopoly was enlarged to cover the commercial application of the new invention, and the company made terms for the use of its patents. The Postmaster-General grants licenses to the companies on certain conditions, the chief of which is the payment of a royalty of 10 per cent. on gross receipts. The United Telephone Company has given concessions for territories to these companies, securing to them the exclusive right to use the patent instruments of the United Company within their respective districts, they paying to the United Company a royalty, and that company in turn engaging not to sell or permit to be used within their respective districts instruments over which it has control. But the Postmaster-General now insists that the subsidiary companies shall bind themselves to supply him with all the telephones he wants, at the lowest possible prices, with which to do as he chooses. The result is thus pointed out: "The condition insisted upon when a subsidiary company applied for a new license w s not only unjust and unfair in itself, but it was absolutely impossible to comply with it. The subsidiary companies, in the first place, have no instruments to sell, for the instruments are the property of the United Telephone Company alone; and even the United Company could only sell the instruments, on a condition with which the Postmaster-General would not comply, viz., that the instruments should not be used in any of the districts of the subsidiary companies. * * * Besides, it is obviously beyond the power of the companies to assent to any such condition, which would absolutely deprive the shareholders of the exclusive rights which they had purchased, and on the faith of which the shares had been subscribed for. * * * In fact, if the condition were acceded to, the entire value of the patent rights would disappear, for the Postmaster-General stipulates for the right to purchase an unlimited number of instruments without any restriction as to how he will use, or to whom he may sell them." This is not a very favorable exhibit of high-minded, public spirited policy, but the particulars are also given of a case in which the department has acquired rights to the use of a certain number of telephones, and uses them for exchanges, although the company selling them—a predecessor of the United—made a distinct contract that the instruments should not be so used.

Some of the other obstacles and vexations with which the telephone companies have to contend in England, we touched upon two weeks ago. It is no wonder that Mr. Herbert Spencer—a writer whose words are carefully weighed—should complain that the department has "impeded the use of the telephone." The *Times* does not hesitate to say that "the permanent post-office officials have spared no pains to place difficulties in the way of the adoption of any improvement by which the prosperity of their bantling (the telegraph) either was or seemed to be imperilled," and that "it has clearly been their fear that any great increase in the use of the telephone would be at the expense of the telegraph." It does not hesitate, moreover, to say that it is humiliating to Englishmen to see the employment of the telephone in other countries, notably our own, and to contrast it with the condition of things to which the English public is subjected. We are not surprised to find it concur in our oft-expressed opinion, that the practical applications of science cannot be safely committed to governmental hands.

What might be affected in England if the people there enjoyed the facilities afforded here by the Bell Company, is shown clearly by the *Postal, Telegraphic and Telephonic Gazette*. In an able article on the limit of telephonic development, our English contemporary, with this long name, says, that at the ratio of the New England Company of one instrument to eighty-three of the population served, the United Kingdom would require almost half a million telephones, and that there is, but for the "unreasonable and unfair gagging policy" of the officials, no good reason why the number of telephones should not be written in six figures.

## TELEGRAPHIC PROSPECTS.

The adjournment of Congress has put an end for a time to all the wild talk of a Governmental monopoly of the telegraph. We have never yet been able to see the necessity for Government interference in any branch of electrical industry so long as our laws leave the means of private competition open and free to all. A vigorous rival like the Baltimore & Ohio, aided by one or two other competing companies, is abundantly able to guarantee the public interests against extortion in telegraphy, while the Western Union staggers along under its heavy load of watered stock. We believe in the let-alone policy so far as the Government is concerned, and we believe also that it would be a very cold day for the American operator when the professional politician could take a hand in the appointment or discharge of telegraphic employés. A Government monopoly would be highly detrimental to the spirit of invention, since, having no competitors to spur it on, it would naturally be content to keep to the old methods for the next half a century. We believe also that the laboring man, who has hardly yet learned to use the telegraph, would, when the matter became clear to him, decidedly object to being taxed for a telegraphic service for rich brokers and others who are using the wires constantly. No post-bellum action of the Government could do more to centralize the Government at Washington than would this reckless scheme to control the telegraph, and probably double our vast army of political office-holders. It is well that the scheme has fallen of its own weight. Cheap telegraphy for all does not lie in that direction.

It is not often that THE ELECTRICAL WORLD has found occasion to rejoice at the consolidation of competing telegraph companies, but it finds some pleasure now in chronicling the amalgamation of all the companies opposed to Western Union. The statement is made that at a conference between officials of the Baltimore & Ohio, Postal, and Bankers & Merchants' Telegraph companies, held on the 5th inst., at the West End Hotel, Long Branch, a memorandum agreement was signed by President Bates, of the Baltimore & Ohio, and representatives of the Postal and Bankers & Merchants' companies, looking to an early consolidation or amalgamation of the three companies. Apparently no definite plan of action and co-operation is ready yet for publication, but the report is that the agreement between the three companies will be based upon their business up to July 1.

It looks as though the Western Union Company, made up of sixty or more of its unfortunate rivals, and for years and years the scavenger of the telegraphic world, has now reached a point at which absorption of its latest and most formidable competitor is impossible. There is nothing so good for the public and operators generally as sound business competition, and we are now in for a good long season of it.

It may not be out of place to suggest that, as the Baltimore & Ohio Company has now spread out and become a national institution, it might as well change its provincial name for something more appropriate. "Baltimore & Ohio" expresses only a local affair, as though the Western Union might have been called "New York & Buffalo." The Baltimore & Ohio has outgrown its name, and, with its usual spirit, might adopt a designation more sweeping and suggestive.

## INTEREST IN THE TELEPHONE.

In electrical circles the telephone maintains its position as the theme of interesting discussion and conversation. To-day's number of THE ELECTRICAL WORLD is a remarkable exemplification of the extent to which the delicate little instrument absorbs public attention. Our principal illustrated article describes the Clay telephone, in which many special points for study will be found. Mr. Berliner, so prominently known in telephony, contributes another valuable article on the practical scope of the Bourseul-Reis apparatus, and Mr. Randall, well known as a telephone inventor, expounds in a very forcible manner his views on the art and the principles involved. We have ourselves discussed, editorially, the grave telephonic situation in England, and we give also a report of the meeting of the New York Electrical Society this week, at which some curious facts were made public relative to early experiments in this city with Reis models. Altogether, our many readers interested in telephony will find we lay before them to-day much that is worthy of their attention.

## NEGLECTED MILITARY TELEGRAPHERS.

Among other important bills left over without final action by Congress is the bill giving to operators of the Military Telegraph Corps of the late war the same standing as other members of the army, including the pension and homestead privileges, to which they are clearly entitled. This fine corps of 1,200 men was a large factor in determining the grand results of the war; its members did purely military service; their camp-life and their duties and responsibility to martial law were the same as those of enlisted men, and the little band lost 199 of its members—killed, died of disease, or captured by the Confederates. It is not just that such good service should go unrewarded, and we hope to see the matter brought up again in a more forcible and successful manner, at an early day after the reassembling of Congress.

## TOO MUCH OF A GOOD THING.

It is stated that arrangements are nearly completed to hold a grand electrical exhibition in Boston the ensuing winter. It is proposed to make the display the most complete in the field of electricity, showing not only the electric lights, telegraphs, telephones, etc, but the less-known branches, and the thousand and one articles that owe their existence in part or wholly to developments in electrical science. We may have too much of a good thing, and if the Philadelphia exhibition should prove the success it promises to be, there will not be a very great necessity for another exhibition in Boston only a month or two later. The wisest thing to do just now, at any rate, is to concentrate all efforts on the Philadelphia Exhibition.

## THE ELECTRICAL APPROPRIATION GRANTED.

All our readers will be glad to hear that before adjourning, Congress agreed to an appropriation of $7,500 to pay the expenses of an international commission, to be appointed by the President, to make tests and measurements of the electrical machines and instruments that will be shown at the Exhibition, and for the other scientific purposes of which we have before made mention. The amount is not so large as was asked for, nor is it adequate to the needs of the case, but still some good work can be done in return, and the country will have no occasion to regret that the appropriation has been made. The Franklin Institute is to be congratulated on the result of its action in the matter.

## SUBMARINE CABLES.

In a very short time, the new Commercial cable will be in working order, and lively times are expected as a result of the new competition. Finding that much interest has been felt in ocean telegraphy, we arranged for the publication of a series of articles on the subject by Mr. Wm. Maver, Jr., the Assistant Electrician of the Baltimore & Ohio Telegraph Company. The articles have been warmly welcomed as both timely and full of fresh information, and the admirable English *Telegraphist* is now re-publishing them, with due courtesy of acknowledgment. The last of the series appears in our present issue.

### Ocean Telegraphy.

BY WM. MAVER, JR.—PART IV.

There are several methods of transmitting signals over cables, but I shall only refer at length to those in use on the Atlantic or other very long submarine cables.

It is well known that electric currents of greater or less strength are continually traversing the earth, and if one end of a telegraph wire should encounter a current of a higher potential than that at its other end, a portion of that current would seek the point of lower potential through the wire. As a matter of fact, that is of almost constant occurrence on telegraph wires; but as these earth currents (as they are termed), as a rule, are of low strength, they do not interfere with the working of ordinary land wires, where powerful batteries and comparatively coarse instruments are used, but on the cable circuits, where, as we have seen, such sensitive receiving apparatus is employed, the slightest foreign currents would seriously interfere with business.

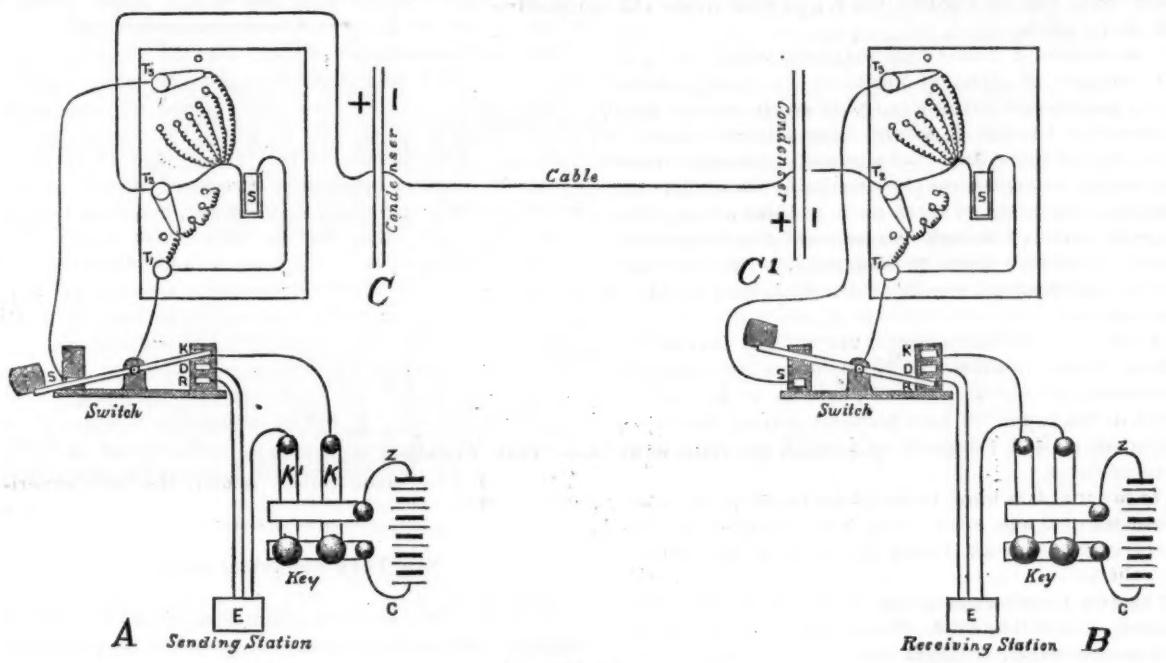



FIG. 11.

To diminish the chances of such interference the cables are kept open at both ends, and signals are transmitted by the aid of that foe of successful submarine cable Morse working, induction, and by the use of condensers in the following manner:

In Fig. 11 $C$ and $C^1$ are condensers constructed on the same plan as the one shown in Fig. 4, and the action, when either of them is put in connection with a battery, is almost similar to the description given of Fig. 4.

The keys $K$ and $K^1$ serve the double purpose of the pole-changer in the well-known polar duplex and the transmitter of the Stearns duplex. In their normal condition they rest against the upper cross-bar, and in this position the battery is practically cut off from the condenser, which, however, is now connected to the ground by the right-hand key.

When one of these keys—for instance, $K$ at $A$—is depressed, it breaks contact with the upper cross-bar and connects with the lower cross-bar, and thus places the positive pole of the battery to the condenser $C$. This charges the plates of the condenser next to the battery, positively. They, in turn, induce in the plates connected with the cable a negative polarity. At the same time the natural or inherent positive electricity of the cable is repelled to the distant end of the cable, as explained in Fig. 3. This repelled positive electricity now, in turn, induces in the ground plates of the condenser $C^1$ at $B$ electricity of a negative polarity.

If now we depress key $K^1$ at $A$, we place a negative pole of the battery to the condenser $C$. This induces a positive polarity in the plates connected with the cable. The inherent negative polarity of the cable in this case is now repelled to the distant end of the cable, and this negative polarity now induces positive polarity in the ground plates of condenser $C^1$ at $B$.

It will thus be seen that in this arrangement there is no actual battery current sent into the cable, and that the impulses which reach the distant end are only of momentary duration, but owing to the sensitiveness of the receiving instruments these impulses are quite sufficient to actuate them.

In Fig. 11 $S$ is either a galvanometer or the signaling coil, as the case may be.

In the present position of the switch at $A$ the system is set for sending; with the switch as at $B$, it is placed for receiving. By reversing the positions of the switches at $A$ and $B$ the above conditions are reversed.

Between each depression of either of the keys the condenser is placed to ground, and thus the cable tends to regain its electrical equilibrium, and thus the galvanometer or coil is allowed to fall back. But even though either of the keys should be held down, so as to keep the battery to the condenser, the receiving instruments would fall back to zero as soon as the electrical impulse thus sent had ceased, for, it will be remembered, it is only while a *current* of electricity is passing through the coil that the magnetic lines of force which move the coil and the needle, respectively, are generated. At the same time, an electroscope would show that so long as the battery is connected to the condenser the cable will be electrostatically charged.

Four depressions of key $K$ would send four positive pulsations to the distant station. This would deflect the needle or siphon recorder four times to one side of the zero line. Similarly, four depressions of key $K^1$ will send four negative pulsations and deflect the receiving instrument four times to the opposite side of the zero line. Thus, if the arrangements were so made at the distant end that the galvanometer needle would be deflected to the right by a positive, and to the left by a negative, pulsation, one depression of key $K$, followed by one of $K^1$, would be the signal for the letter $A$, and so on.

The various coils or curls of wire seen in the diagram are devices to direct more or less of the current to or from the receiving coils, as may be desired.

It occasionally happens that earth currents are so strong that even this method of operating the cables is rendered useless, but this only occurs during the prevalence of severe electric storms. At such times cable-working must be abandoned, excepting at those stations where there may be two or more cables, in which case metallic circuits are formed, thus cutting off all connection with the earth. In some cases the cable is worked with but one condenser, namely, at the sending end, while the receiving end is connected directly to the earth, and I understand that this is really the quickest method of operating the cable. Of course, however, there is more chance of interference from earth currents than when two condensers are used.

Many submarine cables are now worked duplex. This, of course, doubles the working capacity of each cable so duplexed.

On the Anglo-American cables the Stearns duplex system is used. On the French and the American cables the Muirhead duplex system is employed, and on some of the long sections of the Eastern Cable Company—namely, to the East Indies, China, etc., the Muirhead system is also used, while on the short sections of the latter company's routes De Sauty's duplex is employed.

Fig. 12, taken from Culley's "Handbook of Practical Telegraphy," gives a very good idea of the manner of arranging the Muirhead duplex system for cables.

It is well known, that in working ordinary land line duplexes, an artificial line, corresponding as nearly as possible to the actual line is formed by means of a rheostat and condensers. In like manner, cable duplexes are furnished with an artificial cable which is also made as nearly as possible to resemble the actual cable, and thus there are interposed at the requisite intervals on the artificial cable, leaks or escapes through high resistances, etc., as shown in the diagram. The artificial cable is also given a high electrostatic capacity by means of stretches of tin foil. It is highly essential to the working of cable duplex that the first few miles of the cable and artificial cable exactly correspond.

Anyone familiar with the common bridge duplex will readily understand the operation of the above system. I regret that I cannot at this time enter into a fuller description of it.

On several occasions when faults have been developed on the cables, the exact location of the trouble has been detected by inserting artificial faults at various points in the artificial cable until the symptoms produced corresponded with those produced by the actual fault.

It should be stated that while, as above noted, the majority of the cables are arranged for duplex working they are not all so worked, for the reason that business does not always require it.

At present eight of the Atlantic cables are in good working order. The average number of messages sent over all these cables daily is about 1,750 each way, in all 3,500. During the busiest month of the year, namely the cotton-shipping season, the average runs up to about 5,000 per day. The total capacity of these cables is about 10,000 messages per day of 24 hours.

When the duplex or quadruplex systems are used on land lines, considerable time in the aggregate is wasted when the receiving operator loses a word. This is owing to the fact that when he "breaks," he not only stops the operator who was sending to him, but also the other two operators, namely, the other sending and receiving operators, one at each end. For this reason "breaking" is not allowed on the cable duplexes. Instead, when a receiving operator loses a word, he merely leaves a space for that word on the blank, and finishes the message. He then hands it to a clerk, detailed for the purpose, who sends a message called a "P" to the sending office, as follows: "In your No.—— give word after ——," to which the sending office replies: "Q. In No.—— word after —— is ——." This plan has been found to save a great deal of time.

The average length of time required to transmit a message of fifteen words, including the address and signature, over an Atlantic cable, is one minute.

It is not uncommon, however, for an operator to receive

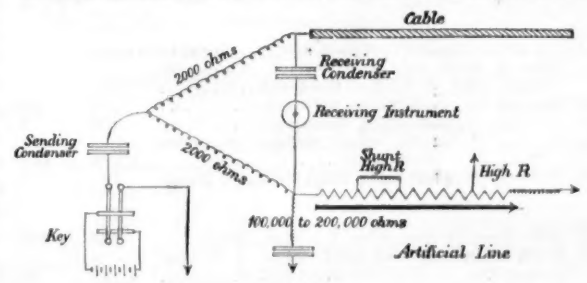



FIG. 12.

50 or 60 short "stock" messages within an hour, but this requires a high degree of skill on the part of the operator.

Mr. J. Brown, the courteous superintendent of the Direct Cable Company, in New York City, to whom I am indebted for many of the above statistics, informs me that on the far Eastern cables they employ what is known as a "human relay," for expediting business at repeating stations. The origin of this rather peculiar term is as follows: For instance, Malta is a repeating station on the route between England and India. The duplex system is used here. At this station the operator who is receiving from London sits at the Alexandria sending instrument, and as fast as a message is received on the recorder he transmits it to Alexandria. On the other hand, the operator who is receiving from Alexandria sits at the London sending instrument, and he also transmits to London the message as quickly as it is received from Alexandria, so that in almost every case there is but little perceptible delay between London and the most remote stations, and at the same time the services of the two extra operators are dispensed with. The salaries of the operators who perform this arduous and skillful work are about one hundred dollars per month, which is, perhaps, equal to about one hundred and fifty dollars in America.

### Electrical Study in Cincinnati.

The class or society formed at Cincinnati some time ago, as mentioned in these columns, for the study of electricity, has, we learn, been doing some excellent work at its regular meetings every Saturday night. Several of the members, including the Secretary, Mr. J. O. Shiras, have left the city for the summer vacation, in consequence of which the society has adjourned to meet again in September at the call of the chair. At the last meeting, Mr. C. E. Jones, of the well-known firm of C. E. Jones & Bro. addressed the society on the construction, use, and calibration of the combination secant, sine and tangent galvanometer constructed by his firm for the benefit of the society. He gave what was, on the whole, a most interesting talk.

AN ELECTRIC BELL.—A description is given in the *English Mechanic* of what appears to be a novel electric bell. The battery is contained in a cylinder of brass, inside which the line wire can be coiled by turning a little winch handle, and the gong is carried at one end of the brass case, serving as a cover for the magnet, etc. The case is provided with legs, so that the arrangement can be placed in a horizontal position, and there is also a ring, which enables it to be suspended wherever it may be desired. The outside dimensions of the whole apparatus are 6 inches by 4 inches.

## Magnetic Polarity and Neutrality.

BY PROF. D. E. HUGHES, F.R.S.

(*Concluded from page 209, vol. 3.*)

Faraday remarked that the magnetic qualities of iron disappeared at yellow-red heat (1,050° C.), reappearing gradually when cooled to red heat (700° C.). The author has found that if we heat the steel to yellow-red heat the whole previous structure disappears, and does not reappear on cooling.

If we place in the coil of the magnetic balance bars of iron or steel of different degrees of thickness, and observe their magnetic capacity whilst under the influence of an electric current, and the degree of remaining magnetism on its cessation, the extraordinary influence which thickness has in allowing space for the opposing waves of polarity to produce instantly a higher degree of neutrality than is possible without its aid, may be observed.

The conditions of the experiments are really those of ordinary electro-magnets; the iron or steel under observation is simply at the time of observation a core of an electro-magnet.

If we place in the coil of the balance different thicknesses of the same diameter and length of iron or steel, we notice a marked rise in its exterior force or magnetic capacity while under the influence of the electric current, and upon its cessation an equally marked return to a more perfect neutrality with each increase of thickness. The following table contains sufficient examples to show this clearly:

TABLE I.

| | | | | Magnetic capacity under influence of the coil. | Remaining magnetism on cessation of the electric current. |
|---|---|---|---|---|---|
| | | | | 1 Daniell element. | |
| | | | | ° | ° |
| 1. | Tube of thin, soft iron, 2 cent. diam., 20 cents. long, $\frac{1}{10}$ millim. thickness | | | 218 | 106 |
| 2. | Similar size solid rod of soft iron | | | 960 | 29 |
| 3. | " " cast steel, tempered | | | 458 | 18 |
| 4. | " " bundle of 1 millim. diameter iron wires | | | 1,268 | 142 |
| 5. | " " glass tube filled with iron filings | | | 160 | 15 |
| 6. | Soft Swedish iron wire, 1 millim. diam | | | 455 | 105 |
| 7. | Hard tempered cast steel wire, 1 millim. diam | | | 49 | 16 |
| 8. | Brass tube | Electro-plated with iron extremely thin | 3 cents. diam. 20 " long. | 0.95 | 0.94 |
| 9. | " | Electro-plated with iron to $\frac{1}{10}$ millim. thickness | " " | 231 | 109 |
| 10. | " | Ditto, 1 mill. thickness | " " | 401 | 72 |
| 11. | " | Ditto, 1 centim. thickness | 4 cents. diam | 1,075 | 35 |

Comparing No. 1 of the table (consisting of an extremely thin sheet-iron tube) with No. 2 (a solid bar of iron of exactly similar size), we have for the thin tube a remaining magnetism of 50 per cent. of its previous polar force, and in the solid bar we have only 3 per cent.; whilst in the solid bar, where the opposing waves of polarity could easily form and produce a near approach to neutrality, we find that its polar force, under the influence of the coil, is 400 per cent. greater than that of the thin tube.

Although, as well known, hard steel has a higher retaining power, still this can be reduced far below that of the soft thin iron if sufficient thickness is allowed, in order to produce the internal reactions. This is shown in No. 3, where a solid 2 centims. diameter of hard-cast steel has double the force of the thin soft iron under polarizing influence, and its remaining magnetism only 4 per cent. of its previous force. This shows clearly that Jamin's views of the superiority of thin steel bars over thick where permanent magnetism is desired, are fully confirmed, as in order to have raised the cast-steel 2-centims. thick bar to a high remaining magnetism, we should have had to employ at least fifty times stronger inducing force than that necessary for the thin bars. The proportion of remaining magnetism in iron or steel to the inducing force is almost similar throughout the entire range up to saturation, where the remaining magnetism is no longer proportional to the inducing power, but remains a constant, no matter how high and powerful the influence excited. The molecules have simply then rotated to parallelism, and cannot rotate further without diminishing its force, and the sudden spring back to a partial neutrality is then the same for all forces above that of saturation. The proportion of remaining magnetism to that of its magnetic capacity under the influence of an inducing field, is shown in Nos. 6 and 7, where iron and steel wires of similar diameter have not a wide difference, the remaining magnetism here being 25 per cent. for iron and 33 per cent. for steel of its proportionate previous force.

The most conclusive experiments, however, will be seen in Nos. 8, 9, 10 and 11. No. 8 being a brass tube coated with an exceedingly thin transparent coat of iron, this thin coating of iron was easily raised to its saturation by a feeble battery, from which point no increase of battery power had the slightest effect, giving always 0°.95. The extraordinary effect of thinness was seen on taking off the inducing influence, no perceptible movement of the needle on the balance occurred, indicating that its retaining power was the same as its capacity, or 100 per cent. of retention; vibrations and hammering which reduce a solid bar at once to perfect neutrality, had no effect. The author has, however, marked it down as 0°.94 as a limit of experimental error; if we assume only 80 per cent. of its previous force, it is still sufficiently remarkable. At No. 9, where the brass was coated to a measurable thickness of $\frac{1}{10}$ millim., we already see a better return to neutrality, having now only 50 per cent. of proportionate remaining magnetism; at No. 10, where we have 1 millim. thickness, we have improved our neutrality by having only 20 per cent., and at No. 11 we have, by means of an increased thickness of 1 centim., almost completely allowed the balancing waves of opposite polarity perfect formation, the remaining magnetism now being only 3 per cent. of its proportional power; and if we even neglect the proportional power, we see that the 1 centim. bar has far less remaining magnetism than that of 1 or $\frac{1}{10}$ millim., while its magnetic capacity is far higher.

No. 4 shows that while bundles of wires have a higher remaining magnetism than solid (due to the want of homogeneity allowing perfect formation of the opposing waves), still, from their increased surface exposed to the inducing effect, they give a higher magnetic effect, the differential effect (as that employed in temporary electro-magnetic and induction coils) is greater, being here for solid bar 960—29=931, and for the bundles of iron wire 1,268—142=1,126 useful effect.

If we require a continuous magnetic effect, as in the field magnets of dynamo machines or small constant electro-magnets for extremely feeble electromotive force, solid cores or bundles of wire of large diameter should be employed, but as the time of charge and discharge increases with the diameter, it would be unsuitable for electro-magnets requiring rapid charges, such as those employed for telegraph relays, large electro-magnets requiring several seconds to charge them to saturation, while extremely small electro-magnets may be saturated in the $\frac{1}{1000}$ part of a second.

The effect of thickness even upon finely-divided iron such as filings is shown in No. 5, where the remaining magnetism is only 9 per cent., against 50 per cent. as shown in No. 1, and we have precisely similar results with thin slices of iron filings as we do with the solid iron in sheets or tubes.

The experiments cited in the paper are of an extremely simple nature, and after being verified by independent observers, we can no longer doubt as to the cause of neutrality.

Whatever theory we adopt as an explanation of evident magnetism, it will be found that neutrality occurring after the cessation of an external inducing force upon a bar of iron or steel, is the result of symmetrically opposed polar forces, producing apparent waves of opposite polarity, or reactions between the exterior and interior of a bar of iron.

## The Progress of the Sawyer-Man Company.

The successful lighting of the Mutual Life Insurance Company's building, in Nassau street, has called attention to the work of the Sawyer-Man Company, by whom the installation was made. Its territory, conceded under contract by the Consolidated Company, includes the whole of New York city. The Consolidated Electric Light Company was organized, and Mr. Sawyer's patents were bought in the Fall of 1882. The company has Edwin S. Thayer as President, Hugh R. Garden as Vice-President, and William Richardson as Secretary and Treasurer. Among the trustees are the Hon. William Windom; Senator Plumb, of Kansas; and Amos Broadnax, of this city. The licensee, the Sawyer-Man Illuminating Company, Limited, has as President William P. Shinn, and Secretary and Treasurer Hugh R. Garden. Among the trustees are ex-Senator Thomas C. Platt, Judge James Keith, of Virginia; Wallace C. Andrews, President of the New York Steam-Heating Company, and Albon Man. Mr. E. R. Knowles is the electrician, and was with Mr. Sawyer as far back as 1878, as his assistant.

The system was first put into practical operation in the United Bank Building, at Broadway and Wall street. From the very start it gave unqualified satisfaction. Many smaller buildings have since been lighted, but the largest plant—and one of the largest incandescent light plants in the United States—has just been perfected and put into operation in the new Mutual Life Insurance Company's building in Nassau street, under the direct personal supervision of Mr. E. R. Knowles, the electrician of the companies. An inspection of the electrical plant shows nine dynamos, which give to the splendid building over 2,000 lamps of 20-candle power each, distributed through the ten floors of the building. The dynamo-room is in the basement. Each pair of dynamos is run by a Westinghouse engine, belted direct to the dynamos. The nine dynamos and four engines present as compact an electrical plant as scientific and mechanical skill can devise. Hundreds of miles of wire are in the building, all cleverly out of sight. Any part of the building can be lighted at pleasure by using one or more engines or dynamos—an admirable economical feature. The lamps are egg-shaped, and, with fixtures of varied and handsome design, are very ornamental. It is a great triumph for the company to have in the finest office building in this country their system of electric lighting. A very large share of credit is due to Mr. William Richardson, of the parent company, and to Mr. H. R. Garden, of the Sawyer-Man, for the success already enjoyed. The latter company is now wiring the *Tribune* Building for its lights.

## An Electrical Exhibition at Boston.

Boston is to have a grand national electrical exhibition. This movement has been contemplated for some weeks, says the Boston *Commercial Bulletin*, by a party of gentlemen in this city connected with the management of fairs, and a decission has now been reached.

The fair will be held in the Massachusetts Charitable Mechanic Association building, opening December first and continuing for six weeks. Mr. P. H. Alexander, late superintendent of the Foreign Fair, in this city, and a gentleman of large experience in fair management in this country and Europe, is working up the new fair with every prospect of success. Leading electric light companies have already decided to exhibit, but the canvass for exhibits has hardly begun.

Boston has never had such an exhibition, and it is believed that it would attract such attention as to assure its financial success. New York is perhaps the centre of electric lighting in this country, but Boston is the centre of telephony and of many smaller electrical interests.

The management are confident that the great fair building can be filled with interesting and instructive exhibits.

The great bulk of exhibits are expected to come under the three heads of electric lighting, telegraphy and telephony. But outside of this broad field there are innumerable electric appliances comprised under heads of electric signals, transmission of power, batteries, metallic depositing, and such classes, which are really "too numerous to mention." Only one who has attended such an exhibition can have an adequate conception of the extent to which electricity has worked its way into nearly every department of art, mechanics and the sciences.

The two industrial fairs will close by the first of November, and that month will be devoted to arranging for the electrical exhibition. It will be national in its scope. Prominent scientists in Boston have advised in favor of the exhibition, which they believe will accomplish much in an educational way.

## New York Electrical Society.

The forty-ninth meeting of the New York Electrial Society was held on the evening of the 9th at Cooper Union. Mr. G. M. Coggeshall read a good paper on under ground conductors for electrical purposes, followed by remarks from Dr. N. S. Keith, who took occasion to point out that the number and extent of aerial wires in New York had been largely overstated. On reliable authority he found that the telephone companies had about 6,000 or 7,000 miles the Western Union about 3,000, and the other companies in proportion. Dr. Keith also drew a plan of a new project for underground conduits and a tunnel under Broadway, in connection with a projected electric railway.

Mr. Lucian J. Blake's able essay on Atmospheric Electricity was read. It was listened to with great attention.

Prof. Vander Weyde, the president, then gave a most interesting exhibition of copies of the Reis telephonic apparatus, made from the original designs of 1860. The exhibition included working models of the various receivers and transmitters of Reis, with improvements of his own. The Professor stated that he gave an exhibition of these instruments as long ago as January 7, 1869, in that very room, at which time the persons present thought they could distinguish articulate sounds, although he then thought it impossible. All that he imagined it to be capable of doing was the transmission of musical sound. The instruments shown certainly transmit articulate sounds. After some interesting remarks on the subject of telephonic invention by Dr. Keith, the society adjourned to meet again on the second Wednesday in October.

BRUSH LIGHTS ALL OVER THE WORLD.—The Cleveland *Iron Trade Review* says: The Brush Electric Light Co. have just received an order for one of their largest dynamos, a 65-light machine, for the City of Mexico. A representative of the company has made arrangements for lighting the City of La Plata, Argentine Republic, and expects to complete arrangements soon for lighting a part of Buenos Ayres. The recent exhibition of Brush lights at Rio Janeiro by the company's agent was a decided success and won the praise of all present. As this is one of the best gas-lighted cities in the world the success was all the more gratifying. Mr. J. Potter, the company's representative at Yokohama, Japan, will return to Cleveland in a week or two via Europe. He has been exceedingly successful in introducing the light in Japan and China. He has established and has in successful operation a plant for lighting Shanghai, has recently contracted for the lighting of several Japanese cities, and has also supplied a great deal of apparatus to the Japanese government for use in its arsenals and navy.

## DEPARTMENT OF INQUIRIES.

While we are pleased to answer in this department all questions of general interest to our readers, and do so without charge for time or expense, we must request those of our patrons who desire information for their personal interest, and who cannot be properly answered in this way to send us with their request a small sum, say from $1 to $5, to pay for the time and the expense incurred for their exclusive benefit.

No. 86.—THE OHM.

"Will you please explain what an 'Ohm' is in electrical measurement?" J. C. M.
MIDDLETOWN, N. Y.

For all kinds of measurements arbitrary units have been provided by law or custom; as, for instance, the foot, pound, minute, meter, gramme, second, etc., etc. Electricians, in convention or congress, have decided to call the unit of electrical resistance an "Ohm" after the celebrated investigator in physics. This unit was arrived at from mathematical considerations too complex to be here considered. Electrical resistance being that resistance which materials offer against the transference of electricity, some stated material which could be readily procured and brought into suitable shape (length and diameter) at any time, has been selected. A column of mercury, 1.06 metres long and 1 sq. millimetre in section, at a temperature of 0° C., has been decided by the Paris Congress of Electricians, to be the suitable standard for the reproduction of that unit of measurement called an Ohm. Familiarity with the term makes it as appreciable as is a foot, a degree of temperature, or a note of music. See "Electrical Units" in our issue of May 24, 1884.

No. 87.—GAS LIGHTER.

"About what size and length of wire will answer for a spark-coil to work one of the pull gas-lighting burners on a short circuit with five Leclanché cells?" R. W. F.
CINCINNATI, O.

It is not necessary to have a coil with five Leclanché cells. Arrange a circuit in direct connection with the battery cells, so that when the pull is operated the circuit is broken at the slit in the top of the burner.

## THE TELEGRAPH.

PROGRESS IN AUSTRALIA.—New South Wales has made rapid progress in electric telegraphy. In 1873 there were but 6,521 miles of wire, 105 telegraph stations, and 365,360 messages sent, In 1882 the mileage had increased to 15,901, the stations to 345. and the number of messages sent to 1,965,931.

THE BENNETT-MACKAY CABLE.—A dispatch from London of July 9 says: A dispatch received last evening from the steamer Faraday, which is engaged in laying the Bennett-Mackay cable, states that she had picked up the Irish coast end 200 miles out and had laid 250 miles more. The weather was fine, and it was expected that the work of laying the entire cable would be shortly completed.

"TAPPING WIRES" LEGALIZED.—A dispatch from London of July 5 says, that in the case of the Central News Agency against the Exchange Telegraph Company for the wrongful appropriation of Egyptian War news, judgment has been rendered for the defendants, with leave to appeal. Practically, this decision gives the English government the right to steal the news of all the papers using its wires.

THE B. & O. ACTIVE.—The termination of the litigation between the Baltimore & Ohio Telegraph Company and the Western Union will enable the first-named company to open several new wires east and south. The new line to Boston, it is expected, will be ready for business within a few days. The Baltimore & Ohio Company proposes to reduce its through rate from New York to Chicago from 40 to 25 cents about the middle of this month.

AN EXHIBITION OF THE SYNCHRONOUS-MULTIPLEX.—The Boston Multiplex Telegraph Co. gave an exhibition last week of the Synchronous-Multiplex system of Messrs. Delany and Callahan. The line between Boston and Providence was used. In five minutes there were sent over the one wire, in six circuits, 793 words while 806 were received. In ten minutes over one wire, using six circuits, 2,244 words were sent averaging about 37 words per minute to each circuit. Very satisfactory tests were also made with the printing telegraphic machine. By its use, 36 messages may be transmitted simultaneously over one wire at a rate equal to 100 messages during ordinary business hours.

## THE TELEPHONE.

POLICE SIGNALS.—The police signal boxes in New Haven are to be provided with an apparatus by means of which a red light can be displayed on any of the boxes by pressing a button at police headquarters. The red light will inform a policeman on his beat at night that he is wanted at the signal station to answer a telephone call from headquarters.

ROGERS TELEPHONE.—The certificate of incorporation of the Rogers Telephone Company, whose lines are to run from this city to Albany and elsewhere, was filed Wednesday in the County Clerk's office. The capital stock is $1,000,000, and it may be increased to $10,000,000. C. Godfrey Gunther, Everett P. Wheeler, D. E. Sickles and William A. Darling are among the incorporators.

CHRISTENED BY TELEPHONE.—President Viele, of the Park Commission of this city, is probably the only person who ever christened a baby by telephone. The child was found in Central Park, and the wretched name of Charlie Cuff was selected for him. General Viele heard of this later in the day, while down town in Judge Barrett's court, went to the telephone, called up the Superintendent of Outdoor Poor, who had charge of the foundling, and ordered that the boy should be known hereafter as Clarence Cleveland.

OFFICIAL CHANGES UNDER THE NEW ENGLAND CO.—The consolidation of the Nashua, Ayer Junction, Concord, Mass., and Fitchburg exchanges of the New England Telephone and Telegraph Company with that in Lowell has caused some changes of officers. Mr. W. A. Tracy, who has acceptably filled the position of local manager at Nashua, has been retired. He will be succeeded by Miss Annie Shedd, who has been in the employ of the company since it was started. Miss Nellie F. Kittredge at Ayer Junction, John C. Friend at Concord, and Arthur H. Kimball at Fitchburg, will continue in charge of their respective local exchanges as heretofore. The new division is to be known as the Lowell division, and the new manager of the consolidation is Mr. A. C. Sanborn, who has been managing the old Lowell division. The headquarters of the new division will be at Lowell.

NEW DRAWBAUGH INTERESTS CAPITALIZED.—The certificate of incorporation of the Drawbaugh Telephone and Telegraph Company, of Canada, was filed on July 3 in New York. The capital stock is fixed at $1,000,000. The lines of the company are to run from this city to Albany, Buffalo, Windsor, Ont., Hamilton, Toronto and Montreal; then to begin again at Albany, to run to Rouse's Point, N. Y., Quebec, Halifax and thence to the different states and territories of the United States and Canada, and across any other countries of the western hemisphere. The certificate of incorporation of the North America Insulated Cable Company was also filed. Its corporators are the same as those of the Drawbaugh company mentioned above. The capital stock of the company is $1,000,000. The objects of this company are to construct lines of electric telegraph and lines of electric cables in the United States and Canada, and to run the cables to the coast of Europe.

## THE ELECTRIC LIGHT.

ELECTRIC HEADLIGHTS.—The Chicago, Milwaukee & St. Paul road is now using electric lights on its locomotives.

LIGHTING POWDER WORKS.—One of the largest manufactories of gunpowder in Germany has been entirely lighted by means of the Bernstein incandescent lamp.

THREE THOUSAND GAS LAMPS RENDERED USELESS.—The recent extension of the use of electricity for street-lighting purposes in New York has put out 3,000 gas lamps.

A NEW UNDERGROUND COMPANY.—The American Underground Electric Wire Co., manufacturing wires and cables for underground service, also conduits for underground wires, capital stock $1,000,000, trustees, John Howe, Geo. Stewart and John D. Beers, has been incorporated in this State.

THE VAN DEPOELE IN CANADA.—The Canada Electric Light and Manufacturing Co., operating the Van Depoele system and patents, are doing a very satisfactory business. They are about to erect a factory to manufacture supplies for use in Canada. The city of Toronto is using their lights, for the streets, and private parties are also patrons on a large scale.

INSURANCE RATES AND THE WIRES.—Last week we commented on the proposal of a paper in this city that extra insurance rates should be charged on property around which wires ran in such a way as possibly to impede fire brigade operations. Several insurance men here say that they do not think an increase of the insurance rates would be brought about on that account.

THE WESTINGHOUSE IN THE WESTERN STATES.—Messrs Fairbanks, Morse & Co., of Chicago, have contracted with the Westinghouse Machine Company, of Pittsburgh, Pa., to control the entire sale of the Westinghouse Automatic Engine in the Western States and the Territories, for a term of years. This contract, which is exclusive, takes effect July 1st, and being closed only after a thorough investigation as to relative merit, becomes a very practical indorsement of the engine in question.

ANOTHER LIGHTING COMPANY.—The Baxter Electric Light Company has bought all the property and patents of the Commercial Electric Company, Limited, of Dayton, O. It includes some twelve patents in all, besides the manufactured property, consisting of plant, dynamos, lamps, etc., mainly the inventions of Mr. Edwards, whose dynamo we illustrated and described fully a short time ago. This purchase will, it is thought, add greatly to the value of the Baxter Company's other acquirements, and will help materially to make it a formidable competitor in the field of electric lighting.

QUICK WORK AT CONEY ISLAND.—A very busy man at the Island last week was Mr. Schermerhorn, the Engineer and Superintendent of the Culver Road. On Monday it was found that extra electric lights were desirable on the beautiful plaza of the company. On Tuesday morning an extra boiler was ordered from Rhode Island and electricians engaged. On Tuesday evening the boiler had been brought to the Island by the railroad company; on Wednesday the foundations for the new boiler were completed and the electric light company's men were at work; on Thursday the boiler was placed in position, and on Friday morning it was furnishing power, and in the evening twelve new arc lights were in operation.

ANOTHER ELECTRIC LAMP FOR THE SURGEON.—Dr. R. W. St. Clair, of Brooklyn, has connected a small incandescent lamp with a portable electric battery. The apparatus is intended to be used in surgery for the illumination of cavities in the body. Many operations in surgery are difficult or impossible on account of the impossibility of lighting up the cavity to be operated upon. With this instrument, combined with the laryngoscope, the throat may be explored to a greater depth than heretofore has been deemed possible. The lamp will be very useful also in dental surgery. It is very small, hardly larger than the head of a pencil. It has even been proposed to use the light for the purpose of photographing cavities of the body. The whole apparatus is about the size of a cigar box.

ELECTRIC HEADLIGHTS.—On the evening of July 1 a practical test was made of the new electric headlight on the New York, Pennsylvania & Ohio Railroad, between Galion and Dayton, and with entire success. The dispatch reporting the test says, somewhat enthusiastically, that the power of the light is wonderful. Thirty-three telegraph poles, a distance of about a mile, can be seen ahead of the engine. The headlight weighs 400 pounds. The light is steady and does not waver a particle. That the light is a grand success there is no doubt. Beside it the common headlight pales into insignificance. It is said that the New York, Pennsylvania & Ohio Company will place the electric headlights on a number of their engines at once. It is considered the grandest railroad invention of the age. It will avert many collisions after night, and thus save many human lives.

MR. ANTHONY ARNOUX COMMITS SUICIDE.—On the 3d inst. Mr. Anthony Arnoux, the treasurer of the Arnoux & Hochhausen Electric Company, committed suicide by shooting himself in the breast at the factory, 221 to 227 East Twentieth street. He had been depressed lately by the slow progress of the company, in which he had invested his property, and felt that he had not the energy to push it as it required. Mr. Arnoux was about 65 years of age, and was born in this city. He was a brother of ex-Judge Arnoux. He had been connected with the Arnoux & Hochhausen Company seven years. He was previously a member of the firm of A. & G. Arnoux, merchant tailors, and during the war had large clothing contracts from the Government. No connection whatever exists between this company and the Excelsior, of which Mr. Hochhausen is the electrician, and which is doing a very large business all over the country.

HOW ACCIDENTS HAPPEN.—A boy was killed recently at Bridgeport, Conn., by handling a wire "crossed" with an electric light wire. Mr. H. D. Stanley, of the Bridgeport Brass Co., made an inquiry into the occurrence, and elicited facts that go to show that blame, if any, attached only to the boys concerned, although the story has been distorted in some papers in order to "bear" the electric light. It appears that a number of boys, from eight to fourteen years of age, having picked up a piece of iron telephone wire, threw it over the electric-light wires running through the streets, and sawed it back and forth until they cut through the insulation of the electric-light wire, down to the bare copper. No harm resulted so long as the current was off, but, of course, as soon as the wire was in active service the natural result of contact followed, and one of the boys was killed by the shock. The coroner's jury exonerated the lighting company from all blame.

## MISCELLANEOUS NOTES.

RAILWAY POLES IN MASSACHUSETTS.—By request of parties, the hearing on the legislative resolve relative to the occupation of railroad locations by telegraph and telephone companies, which was to have taken place before the Railroad Commissioners Thursday, was postponed to September 17.

BOILERS FOR THE EXHIBITION.—The Babcock & Wilcox Co., makers of safety steam boilers, 30 Cortlandt street, this city, have just completed a contract to furnish and put up four of their 208 horse-power boilers at the International Electrical Exhibition to be held in Philadelphia. These boilers will be set in two batteries, two to each, combining a nominal capacity of 832 horse-power.

TRANSMISSION OF POWER.—MM. de Meuron and Cuenod, of Genoa, have fitted up the appliances for transmitting 30 horse-power by electrical agency to a distance of nearly 4,000 feet through a copper wire .276 inch in diameter (No. 2, new gauge) at the works of MM. Blosch-Neuhaus, Biel, Switzerland. The Thury dynamo-electric machines are used, and run at 500 revolutions per minute. These machines are multipolar in the form of a hexagonal prism, the armatures resembling those of the Siemens machines, but differing in the method of coupling the wires.

MAGNETIC, OR ONLY STRONG?—A prominent physician in New York says emphatically that Miss Hurst possesses no extraordinary power and that her claims are not entitled to any consideration at the hands of professional men. "When you were a boy," he said, "and got into a fight with another boy whom you were sure could thrash you, did you ever notice how easily you were licked? That's the whole of it. Miss Hurst has cultivated the power she has over minds of others—people all have that power more or less—and then uses her force to advantage. There's a great deal in concentrating force. Look at men who have jumped ravines in the excitement of a fight and who have done other things they would have deemed impossible before and even then, except that they forgot themselves. Did you ever see a Japanese juggler climb a slender pole that you thought a lighter man would have broken? It's the live weight he manages skillfully that does it. Live weight may be controlled and force concentrated. Everybody at the theatre this afternoon was simply deceived, but you probably can't convince them of it. They seemed to be struggling and were struggling, but doing just the things they didn't want to do. They don't believe it, of course. I don't deny the existence of some unexplained power, but don't care enough about it to begin any investigation. The power Miss Hurst exercises is nothing more than concentrated muscular effort aided a little by her will power."

INFLUENCE OF STRESS ON THE ELECTRICAL RESISTANCE OF IRON AND STEEL WIRES.—In the *Proceedings* of the Manchester Philosophical Society, Mr. W. H. Johnson, B. Sc., describes some experiments made by him as follows: A piece of piano steel wire, about 0.40 inch diameter, was found to have a resistance of 0.418 ohm. A heavy longitudinal stress causing a temporary elongation of 3 per cent., but not sufficient to produce any permanent strain, was applied, and the resistance observed was 0.422 ohm, the temperature in both cases being the same. If the resistance per meter gramme of the wire had been unaltered by the *stress*, the observed resistance of the wire under stress should have been 0.443 ohm, or some 5 per cent. more than that observed. The resistance of hardened and tempered steel wire thus appears to *decrease* 5 per cent under stress. Experiments were next made on hard iron wire, about the same diameter as above, 1.774 metre long and 0.2274 ohm resistance. Under longitudinal stress, causing a temporary elongation of 0.33 per cent., the resistance was found to be 0.232 ohm. Now, if the wire had been unaltered in resistance by stress, the observed resistance should have been 0.229 ohm. Thus it appears that the resistance of hard or unannealed iron wire, unlike piano steel, is *increased* by stress some 1½ per cent. The figures denoting the percentage of change of resistance caused by stress are of course only approximate, but serve well to denote the direction of the change. In both sets of experiments the iron and steel wires returned to their original resistance when the stress was removed. The stress applied to the steel wire was many times

that applied to the iron wire, so it is just possible that the steel wire under a small stress would have behaved like the iron wire and increased in resistance. The stress applied to both iron and steel wires was the highest they would bear without permanent change of length.

## STOCK QUOTATIONS.

Telegraph, telephone and electric light quotations on the New York Stock Exchange, in Boston and elsewhere are as follows:

TELEGRAPH.—Am. Cable, b 50¼, a 50⅝; Bankers and Merchants', a 30; Western Union, b 54½, a 54¾.

TELEPHONE.—At Boston on the 9th, telephone stocks were quiet, American Bell selling at 153, New England at 18 and Mexican at 1¾.

Erie telephone shares were 17 bid this morning, says the Boston *Herald* of the 10th. The directors meet Saturday to consider the dividend and floating debt questions, the latter being intimately associated with the former. The company owed July 1 about $200,000 gross, of which one-half can be easily carried, and the balance matures at different times within six months. The company is earning net at the rate of about 6 per cent. on the stock, or $228,000 per year. Some 2 per cent., or $96,000, is needed for construction, leaving a balance of $192,000 for dividends and other uses. If the whole amount is distributed, the floating debt must be carried, and it will probably require the individual indorsement of directors. Some of the board are opposed to this course, and consequently opposed to paying a dividend until the debt is in better shape. Others are in favor of a dividend, and have declared all along that one would be paid. A compromise is possible, and if it is made it is likely to be on the basis of 2 per cent. per year for the shareholders, 2 per cent. for construction and 2 per cent. for the debt. This would, it is calculated, clear up the debt in two years on the present basis of earnings. Any gain in earnings—and a gain is expected—would, with conservative management, reduce the debt earlier and lead to an increase of dividends. A dividend of 50c. per share July 25 is the present probability. This would be a reduction of 50c. from the last quarterly payment.

Mexican telephone shares were steady at 1¾. The treasurer is receiving a remittance of $1,000 per month from Mexico, and everything is reported running smoothly. Having obtained everything desired from the government, the future of the company is a question of development.

ELECTRIC LIGHT.—Baxter, b 22, a 22.50; Brush, b 50, a 80; Daft, a 90; United States, b 75, a 95; U. S. Ill. Co., a 90.

Kohlsaat & Co., No. 30 Pine street, furnish the following quotations for miscellaneous securities:

| | About. | | About. |
|---|---|---|---|
| American Elec. Light..... | 9 | Time Telegraph..... | 25 |
| U. S. Electric Light..... | 90 | Postal Telegraph ..... | 5 |
| Dexter Electric..... | 100 | " " bonds.... | 40 |
| Commercial Tel. & T..... | 63 | Bankers & M.' Tel. bonds.. | 24 |

## BUSINESS NOTICES.

MESSRS. EARLE & ELLIOTT, 13 Park Row, call special attention to their electric alarm steam gauge, which can be arranged to notify any or all officers of a company or firm when steam is above or below a certain pressure. They have also an electric low water alarm attachment, which can be arranged to notify any one at any point designated.

LAVA INSULATORS.—The D. M. Stewart Mfg. Co., of Cincinnati, O., of whose lava insulators a description has been given in these columns, have moved into much larger quarters at West Sixth street and Mt. Hope Road, that city, where they will have ample room to manufacture their exclusive line of goods, which are all under their own patents.

THE CLARK INSULATED ELECTRIC WIRE CO.—This company has moved into fine offices at 419 Chestnut street, Philadelphia, and has the entire services of Mr. J. Chester Wilson for the General Managership. With additional machinery and improved processes, it will proceed with the production of the best insulated wires and cables. The business is already large, but the company intends to increase it. The Clark principle is covered by eleven patents, and the wires and cables have been supplied to and are in use by the Western Union, B. & O. and American Rapid Companies, the Bell Company, the Union Switch Co., the Brush, Edison, N. E. Weston and other electric light companies. Samples, estimates and information furnished upon application.

# OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

**Edited by N. S. KEITH, Electrical Engineer and Expert, 9 Murray Street, New York.**

## PATENTS DATED JUNE 24, 1884.

**Arc Lamps**; *F. M. Newton*, of Belfast, Ireland..... 300,899

The feeding of the carbons is effected by a device moving with a vibrating motion.

**Connector for Electric Conductors**; Ed. Weston, of Newark, N. J., Assignor to the U. S. Electric Lighting Co., of N. Y ..... 301,026

Composed mainly of a pair of plates, each having a socket attached to or formed as a part of itself. The receptacles are coated on their interior with tin, and the conductors are introduced into them and secured by means of solder, which is run in by heat applied to the socket.

**Dynamo-Electric Machine**; Edward Weston, of Newark, N. J., Assignor to the U. S. Elec. Lighting Co., of N. Y..... 301,025

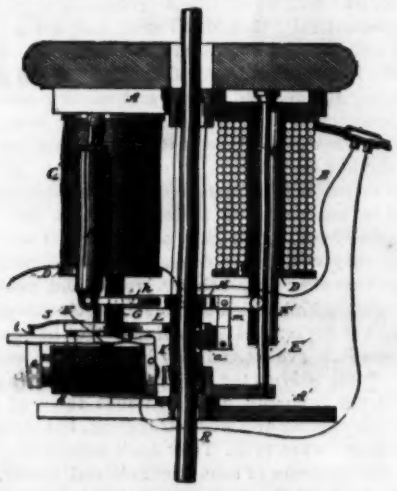
The conducting wires on the armature core are proportioned in diameter to their distance from the centre of the core.

**Electrical Circuit Breaker**; Edward Weston, of Newark, N. J., Assignor to the the U. S. Electric Lighting Co. of N. Y..... 301,023

Uses a contact plate mounted on a suitable spindle and partly surrounded or inclosed by pieces of insulating material, and springs which impinge thereon. The plate has such a form that the springs themselves tend to turn the plate around out of circuit.

**Electric-Arc Lamp**; Ed Weston, of Newark, N. J., Assignor to the U. S. Electric Lighting Co., of N. Y.. 301,076

The operation of the lamp is as follows: When the current is directed through the carbons and magnets, the helix *B* draws up its core, tilts bar *H*, and causes the clamping device to bind and raise the rod *R*. This condition of things continues until, by the consumption of the carbons and the increased attractive power of the helix *c*, the contact-strip on the end of lever *L* is brought down into contact with the contact-stop *t*. The armature *f* is by this means set into rapid vibration, which movement is im-



parted to the lever *L*, whereby it is caused to drop by imperceptible degrees, the carbon-rod *R* until, by the approximation of the carbon-points and the increasing attraction of the helix *B*, the strip *S* is raised out of the range of movement of the armature *f*. The latter, in consequence of this, ceases at once to vibrate. The action described is repeated until the carbons are consumed, the operation of the clutch or clamping devices being such that the rod *R* is at no time released from them for a sufficient length of time to permit the upper carbon to fall into contact with the lower.

**Electrical Conductor**; Ed. Weston, of Newark, N. J., Assignor to the U. S. Electric Lighting Co., of N. Y..... 301,031

One or more fine wires are laid parallel to a larger main wire, and between the insulating jackets.

**Electric Motor**; Wellington Adams, of St. Louis, Mo., Assignor to the Adams Electric Co..... 300,827

A combination of an electric motor enclosed within a car-wheel, or casing attached thereto.

**Electric Motor for Railway Cars**; A. Wellington Adams, of St. Louis, Mo., Assignor to the Adams Electric Co..... 300,828

Mounts the armature upon the axle of the driving wheel or wheels, and supports the field magnets in a frame which is rigidly secured to or formed in one with the axle-boxes of the wheels.

**Electric Regulator**; Ed. Weston, of Newark, N. J., Assignor to the U. S. Electric Lighting Co., of N. Y.. 301,028

A magnetic motor is used to move a conducting arm over a circular range of contact plates connected in series with resistance coils. Movement of the armature introduces more or less resistance into a circuit with which it is connected. A spring controls the distance of rotation of the armature.

**Electric Valve for Regulating Temperature**; W. S. Johnson, of Milwaukee, Wis., Assignor of one-half to William Plankinton, of same place..... 301,059

With the view of operating a steam, gas or water valve from a distant place, the valve is connected to the expansible wall of a chamber in which the steam, gas or water is admitted either from the main passage or from an independent source through a small electrically-controlled valve.

**Junction Device for Electric Circuits**; Ed. Weston, of Newark, N. J., Assignor to the U. S. Electric Lighting Co., of N. Y..... 301,029

The junction boxes contain two plates or castings adapted to be applied to the outer cover, and provided with parts that extend down into the grooves of the under slat and make connection with the conductors contained thereon.

**Manufacture of Carbon Conductors**; Ed. Weston, of Newark, N. J., Assignor to the U. S. Electric Lighting Co., of N. Y..... 301,024

Collodion is mixed with oil, formed into right shape, the oil is removed by solvents, the collodion is converted into cellulose, and then carbonized.

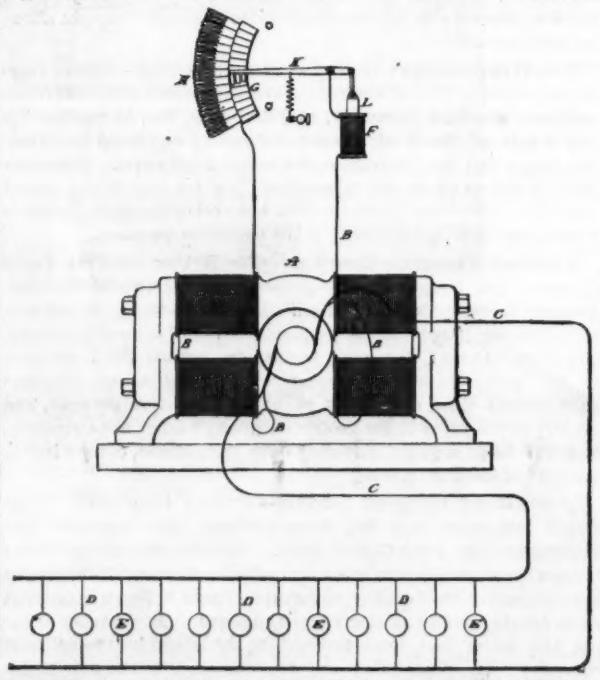
**Process of and Apparatus for the Separation of Metals from Ores and Alloys**; H. R. Cassel, N. Y. City..... 300,950

A rotable anode chamber of porous insulating material is used in the vat which contains the cathode; and a solution from which chlorine is freed by electrolytic action. The ore is placed in the anode chamber.

**Dynamo-Electric Machine**; Ed. Weston, of Newark, N. J., Assignor to the U. S. Electric Lighting Co., of New York..... 301,027

*A* is a dynamo-electric machine constructed for developing a constant electro-motive force, and having a derived field-circuit, *B*.

*C C* are the main conductors from the commutator; *D*, the



cross-circuits, and *E* the incandescent lamps or similar devices included therein.

*F* is an electro-magnet, or its equivalent, such as a helix and core; *G*, a series of contact-plates; *H*, a series of resistance-coils connected therewith in the ordinary way.

*K* is a pivoted contact-arm connected to the core or armature *L* of the magnet. The coils of the magnet or helix are included in the derived field circuit. The rheostat is set or adjusted to include a certain resistance in the field circuit during the normal running of the machine. If, for any cause, the speed of the machine should increase, the tendency of a stronger current to flow through the field circuit is checked by the operation of the rheostat, which inserts a greater resistance in the circuit. The converse of this takes place upon a diminution of the speed. In this way the magnetism of the field is preserved uniform, so that the ordinary variations of the speed of rotation of the armature—such as are likely to occur in practice—produce slight variations in the electro motive force developed by the machine.

**Process of Chloridizing Ores by Electrolysis**; H. R. Cassel, N. Y. City..... 300,951

Apparatus and solution used like that of No. 300,950, but lime is added to neutralize acids formed by secondary action.

**Safety-Strips for Electric Circuits**: Ed. Weston, of Newark, N. J., Assignor to the U. S. Electric Lighting Co., of N. Y..... 301,030

A fusible metal safety-strip, containing slots or insulating divisions.

**Secondary Battery**; George L. Winch, of Madras, East Indies..... 300,953

The novel features are, first, the use of cork or vegetable pith as a protector to the deposits on the plates; second, the use of the aqueous solutions of the salts of aluminium as the electrolytic fluid, etc.

**Static Compensator for Telegraphs**; Francis W. Jones, of New York City..... 300,781

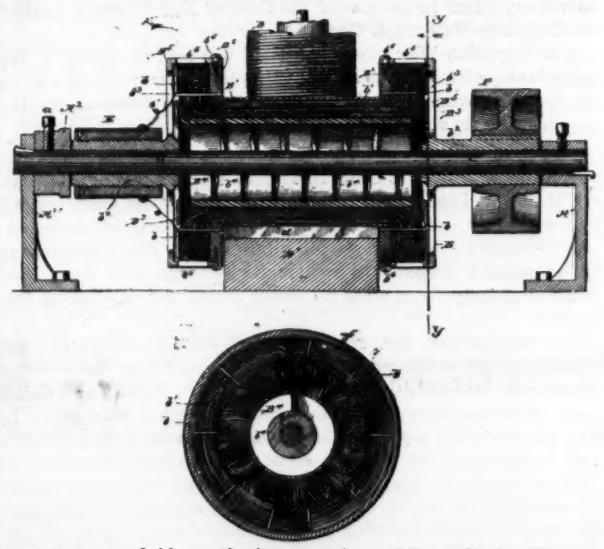
A neutralizing or compensating coil is arranged to exert an effect upon the receiving instrument counter to that consequent upon the static and discharge of the line, and connected with the secondary of an induction coil, the primary of which is connected into the line circuit in such a way that when the signaling battery is placed to line its current will flow through the primary and set up a current in the secondary in one direction, while, *vice versa*, when the signaling battery is withdrawn, its current will cease to flow in the primary, and thus cause a momentary induced current in the secondary in the opposite direction.

**Telephone Call Annunciator**; Charles W. Howard, of Neenah, Wis..... 300,976

The ringing of the bell trips a disc which then falls into a new position. This new position denotes that the bell has been rung.

**Dynamo-Electric Machine**; John B. Blair, of Chicago, Ill., Assignor to the Blair Electric Co., of same place..... 300,835

*B* is a rotating cylindric armature mounted on a shaft, *C*, which is supported from the base *A* by means of uprights *A' A'*. *D* is a stationary electro-magnet, secured with its poles *d* proximate to the outer cylindric surface of the armature, and *D'* is the direct support for the magnet. *E* is a commutator attached to the armature. The armature is of the shell type, and, as here represented, has an outer cylindric casing, consisting of a thin cylinder, *B'*, of brass or other diamagnetic substance. Said cylinder has secured to each of its ends an outwardly-projecting circular flange, $B^2$. From the outer plane face of this flange, and near its inner margin, project a series of pins, *b*, which may be alternately of different lengths, and which may, at their outer ends, be bent outward parallel with the adjacent plane face of the flange, as seen in Fig. 2. The insulated wires *b'*, forming the induction coils $B^3$ of the



armature, are laid on the inner surface of the cylinder *B'*, parallel with its axis, and are trained over or outside the projecting pins *b* around one-half the circumference of the flanges $B^2$, and thence into and along the opposite side of the cylinder *B'*. As many coils or groups of wires may be employed as may be considered necessary or desirable, and they may overlie each other or lie side by side within the cylinder, as may be found convenient. Within the cylinder thus lined with wire coils is placed the soft-iron core. As shown in Fig. 2, said core consists of a second cylinder of soft iron, $B^4$, preferably in contact with the wires *b'*, and adjusted concentrically with the axis of the armature. The double cylinder, composed of the metallic cylinders *B'* and $B^4$, and inclosing the wires *b'*, is supported from its axis by means of heads $B^5$, made of brass or other diamagnetic material, and consisting of the hubs $b^2$, arms $b^3$, and rim or flange $b^5$. Said heads are secured to the flanges $B^2$ by means of screws $b^4$, passing through the free margins of the rims $b^5$, and radially into the periphery of the flanges $B^2$, as plainly indicated in Fig. 2. The shaft *C* is preferably non-rotating, and the hubs $b^2$ are in that case fitted to turn thereon, as also shown in Fig. 2. One of said hubs carries the pulley *P*, and either or both may be provided with a commutator *E*, with the slats or segments of which the several coils are connected in any of the well-known modes, as indicated in the drawings. The armature *B* is held longitudinally in position upon the shaft *C* by any suitable means, an adjustable collar $A^2$, secured to said shaft by a set-screw *a*, and the hub of the opposite upright herein serving such purpose.

**Transmitter for Printing Telegraphs**; Stephen D. Field, of New York City, Assignor to the Commercial Telegram Co., of the same place..... 300,859

Devices having for their object to furnish a rapidly and easily manipulated transmitter capable of controlling a large number of printing-telegraph circuits, each of which may, in turn, contain a large number of printing telegraphs, and which, in addition, shall automatically control the circuit or circuits for positioning the type-wheels and the circuit or circuits for effecting the printing.